DEVELOPMENT OF DATA SETS ON JOINT CHARACTERISTICS AND CONSIDERATION OF ASSOCIATED INSTABILITY FOR A TYPICAL SOUTH AFRICAN GOLD MINE

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I declare that this dissertation is my own, unaided work. It is being submitted for the Degree of Master of Science in Engineering in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University

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ABSTRACT

The occurrence of fracturing due to high stress levels is a major factor with regard to hangingwall stability in deep level gold mine stopes. However, rock falls cannot be the result of these fractures alone. Blocks in the hangingwall strata must be defined by a combination of the stress induced fractures and naturally occurring geological planes of weakness. These planes include bedding planes and joint planes. The importance of the natural joints and bedding planes in defining the instability has not been given the attention that it deserves, to the extent that there are apparently no documented, published data available on joint set characteristics. This is perhaps an indication that such data do not exist on the mines. To remedy this situation, detailed scan-line joint mapping exercises have been carried out in several geological environments in two gold mines. The joint data collected on joint geometry included orientation, spacing and length. The results presented in this dissertation are believed to be the first such data available on jointing in gold mines. The main conclusions from the interpretation of these data are that there are two dominant joint sets in stope hangingwalls and at least one of these sets is shallow dipping. In development tunnels there is one predominant set of shallow dipping bedding planes. Both in stope hangingwalls and in development tunnels, steeply dipping random joints constitute half of the mapped joints.

The statistical joint data obtained was used to investigate and analyse the potential for rock falls in stopes. This involved the prediction of characteristic block parameters such as expected block sizes and rock fall thicknesses. These predictions show good agreement with measurements made of actual rockfalls (generic results). Most unstable blocks in stope hangingwalls are less than a cubic meter in size. These blocks are more likely to fall between support elements than fail the supports, whilst failure of the fewer large blocks (20%) usually involves failure of support elements. It is concluded that failure probabilities are largely related to joint geometry. Common failure modes for small blocks are single plane

sliding and ‘dropping out’ whilst larger blocks usually fail by rotation. The study increases understanding of rock fall mechanisms and the support-block interaction. The results of the analyses of block stability that have been reported in this dissertation show disturbingly high probabilities of failure in the stope face area (or working area), particularly for blocks that are smaller than about 1.5 cubic metres in size.

The study has demonstrated the important influence that natural joints have on hangingwall block stability, and the importance of joint mapping to produce statistical joint data that can be used in the assessment of stability against rock falls. Although joint mapping may be a tedious exercise in mines, it has been shown to give similar results regarding heights of rock falls to that interpreted from collection of empirical incident and accident record data over a ten-year period. It is considered that this could provide good input data for the design of stope support.

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To ……………………………………………………CELINE (New day.....)